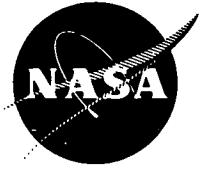


# NASA TECH BRIEF

## *Lewis Research Center*



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

### Regenerative Cooling Design and Analysis Computer Program

This computer program was written for the design and analysis of regeneratively cooled rocket engines; however, the program may be used for the design and analysis of any convectively cooled or heated device.

The severe thermal environment encountered by the thrust chamber walls of a rocket engine necessitates some form of cooling. One of the more common cooling methods is regenerative cooling in which one of the working fluids, usually the fuel, is employed to continually cool the thrust chamber walls. The design of an efficient cooling system requires detailed evaluation of the hot-gas-side and coolant-side influences by calculating the simultaneous thermal and fluid dynamic balance incrementally along the length of the structure. As with most cooling systems, minimum coolant pressure drop compatible with acceptable wall temperature distribution is desirable. This computer program makes these analyses.

The program evaluates the influences of heat transfer, stress and cycle life. Coolant passages may be tubes or channels, with or without a gas-side wall coating. Passages may be designed on the basis of a specified gas-side wall temperature, coolant-side wall temperature, or coating temperature distribution. A design may be analyzed with a specified coolant passage size distribution to determine the resulting wall temperatures and coolant pressure drop. Program options include a two-dimensional thermal analysis model of a tube or channel cross-section using a relaxation technique with a variable number of nodes. Also, a transient thermal solution is provided by a quasi two-dimensional thermal model for considering startup, shutdown and throttling influences. Another option is the determination of structural safety and cycle life of a design.

#### Notes:

1. This program was written in FORTRAN IV for use on the IBM 360/67 computer.
2. Inquiries concerning this program should be directed to:

COSMIC  
Information Services  
112 Barrow Hall  
University of Georgia  
Athens, Georgia 30602  
Reference: LEW-12110

Source: J.G. Gerstley and R.D. Tobin  
Rockwell International  
under contract to  
Lewis Research Center  
(LEW-12110)

Category 09